Overview of the Florida Stream Condition Index

The Stream Condition Index (SCI) is a multi-metric index that assesses the biological health of stream ecosystems by the evaluation of the population and diversity of macroinvertebrates that are found in a 100 meter stream reach. Several anthropogenic factors, including sedimentation, nutrient enrichment, habitat loss, hydrologic stream channel alteration, and riparian zone alteration, adversely influence the biological health of stream ecosystems **(Table 1)**. The bioassessment procedures, along with standardized habitat assessments provide evidence to determine the ecological health of a stream.

TABLE 1. Principal mechanisms by which land use influences stream ecosystems (modified from Allen, 2004).

Environmental Factor	Effects
Sedimentation	Increases turbidity, scouring and abrasion; impairs substrate suitability for periphyton and biofilm production; decreases primary production and food quality causing bottom-up effects through food webs; in-filling of interstitial habitat harms crevice-occupying invertebrates and gravel-spawning fishes; coats gill and respiratory surfaces; reduces stream depth heterogeneneity, leading to decrease in pool species
Nutrient enrichment	Increases autotrophic biomass and production, resulting in changes to assemblage composition, including proliferation of filamentous algae, particularly if light also increases; accelerates litter breakdown rates and may cause decreases in dissolved oxygen and a shift from sensitive species to more tolerant, often non-native species
Contaminant pollution	Increases heavy metals, synthetics, and toxic organics in suspension associated with sediments and in tissues; increases deformities; increases mortality rates and impacts to abundance, drift, and emergence in invertebrates; depresses growth, reproduction, condition, and survival among fishes; disrupts endocrine system; physical avoidance

Hydrologic alteration	Alters runoff-evapotranspiration balance, causing increases in flood magnitude and frequency, and often lowers base flow; contributes to altered channel dynamic, including increased erosion from channel and surroundings and less-frequent overbank flooding; runoff more efficiently transports nutrients, sediments, and contaminants, thus further degrading in-stream habitat. Strong effects from impervious surfaces and stormwater conveyance in urban catchments and from drainage systems and soil compaction in agricultural catchments
Riparian clearing/canopy opening	Reduces shading, causing increases in stream temperatures, light penetration, and plant growth; decreases bank stability, inputs of litter and wood, and retention of nutrients and contaminants; reduces sediment trapping and increases bank and channel erosion; alters quantity and character of dissolved organic carbon reaching streams; lowers retention of benthic organic matter owing to loss of direct input and retention structures; alters trophic structure
Loss of large woody debris	Reduces substrate for feeding, attachment, and cover; causes loss of sediment and organic material storage; reduces energy dissipation; alters flow hydraulics and therefore distribution of habitats; reduces bank stability; influences invertebrates and fish diversity and community function

The SCI method consists of collecting 20 D-frame dipnet sweeps (0.5 m in length) of the most productive habitats in a 100 meter reach of stream. The organisms are sub-sampled, sorted, and identified to the lowest practical taxonomic level. The resulting data is used to calculate the SCI which is based on ten biological metrics of invertebrate health **(Table 2)**. The points from each of these metrics **(Table 2)** are then summed to determine an overall score of biological health, with scores of 64-100 considered “exceptional”, scores from 40-63 considered “healthy”, and scores of 0-39 considered “impaired.” (FDEP, 2014).

TABLE 2. Description of SCI metrics and expected effects of human disturbance

SCI Metric	Description and expected effects due to human disturbance
Total taxa	Represents a general measure of the biological complexity found at a site. Widely applied in biomonitoring programs because of its consistent decline with human disturbance for stream invertebrates.
Ephemeroptera taxa	Ephemeroptera are considered pollution sensitive so numbers and taxa will decline as human disturbance increases.
Trichoptera taxa	Trichoptera are considered pollution sensitive so numbers and taxa will decline as human disturbance increases.
% Filterer	Feed on fine particulate matter that they filter out of the water. Are expected to decline in response to disturbance because of the increase in sediment and silt that can damage or clog nets or filtering structures.
Long-lived taxa	Taxa that spend at least one year of their lives in an aquatic habitat. Long-lived taxa are expected to decline as human disturbance alters naturally flow regime, because these taxa require water in the channel year round. Pollution events of short duration may also eliminate these taxa, while other taxa may colonize from unaffected sites.
Clinger taxa	Clingers have morphological and behavioral adaptations that allow them to cling to objects in fast water. Human development near stream sites in FL often translates into eroding sand that can smother habitat and eliminate taxa.
% Dominance	Percentage dominance of the most abdundant taxon increases with disturbance as the natural taxonomic diversity declines and very tolerant taxa dominant samples.
% Tanytarsini	Members of the family Chrionomidae. Generally sensitive to human disturbance.
Sensitive taxa	Historically documented taxa that are considered sensitive to human disturbance in FL.
% Very tolerant	Historically documented taxa that are considered very tolerant to human disturbance in FL.

Habitat Assessment

Eight attributes known to have potential effects on the stream biota are evaluated and scored, including the categories of substrate diversity, substrate availability, water velocity, habitat smothering, artificial channelization, bank stability, riparian buffer zone width, and riparian zone vegetation quality. Based on the sum of these individual scores, overall habitat quality is assigned to one of four categories: Optimal, Suboptimal, Marginal, or Poor **(Table 3)**.

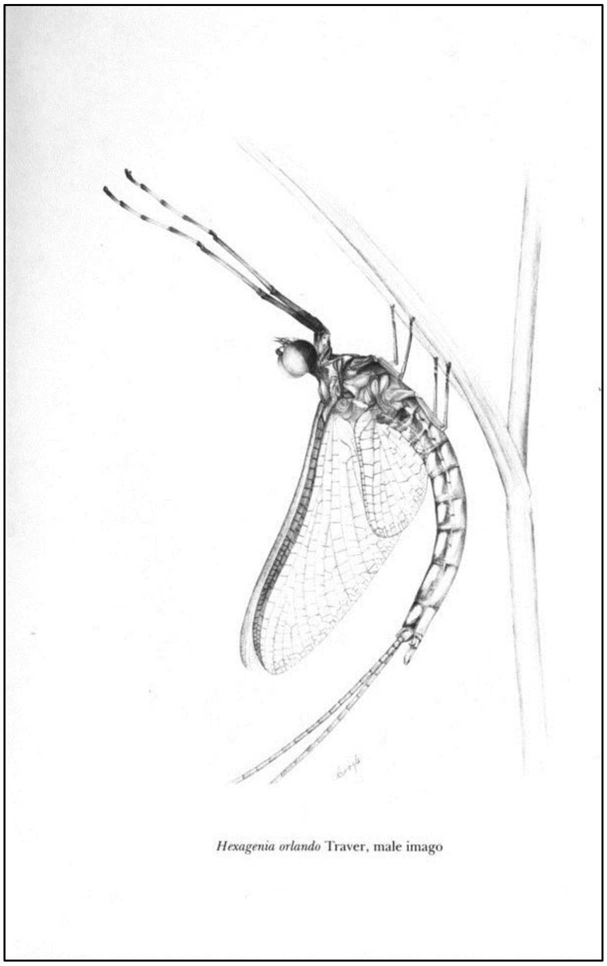
TABLE 3. Habitat Categories and Scoring Ranges.

Habitat Assessment Category	Score Range
Optimal	120-160
Sub Optimal	80-119
Marginal	40-79
Poor	8-39

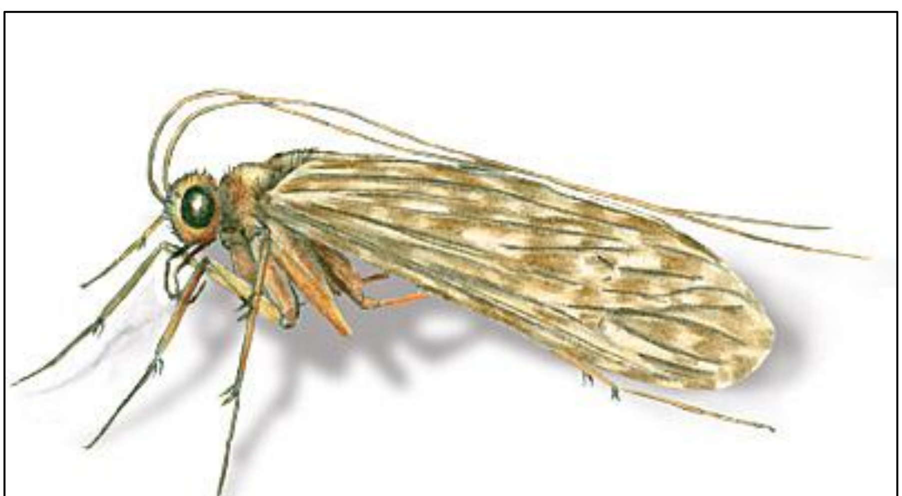
References

Allen, J., David. 2004. Landscapes and Riverscapes: "The Influence of Land Use on Stream Ecosystems." In: Annu. Rev. Ecol. Evol. Syst. 35:257-84. Annual Reviews.

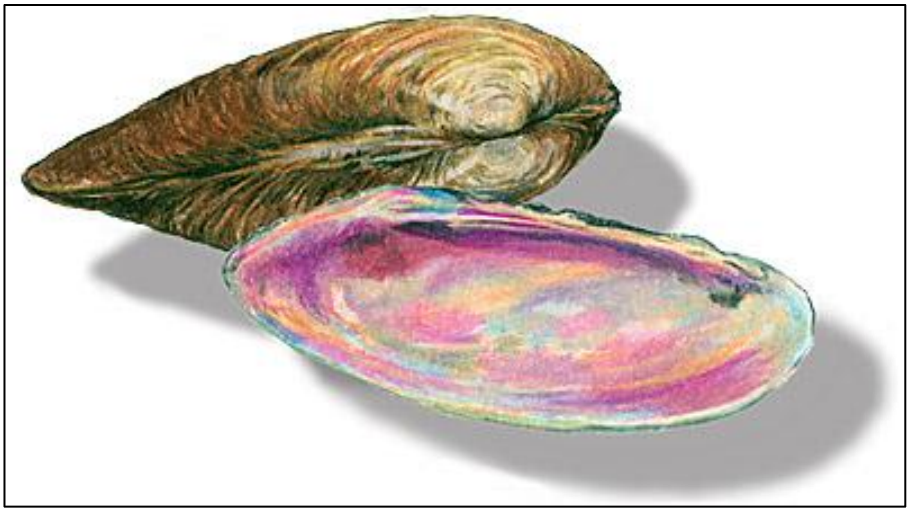
Florida Department of Environmental Protection (FDEP). "Development and Application of DEP Bioassessment Methods." *DEP Bioassessment*. Web. 17 Feb. 2014. http://www.dep.state.fl.us/water/bioassess/methods.htm#Streams



Example of Ephemeroptera (mayfly) taxa from Mayflies of Florida, Berner and Pescador.

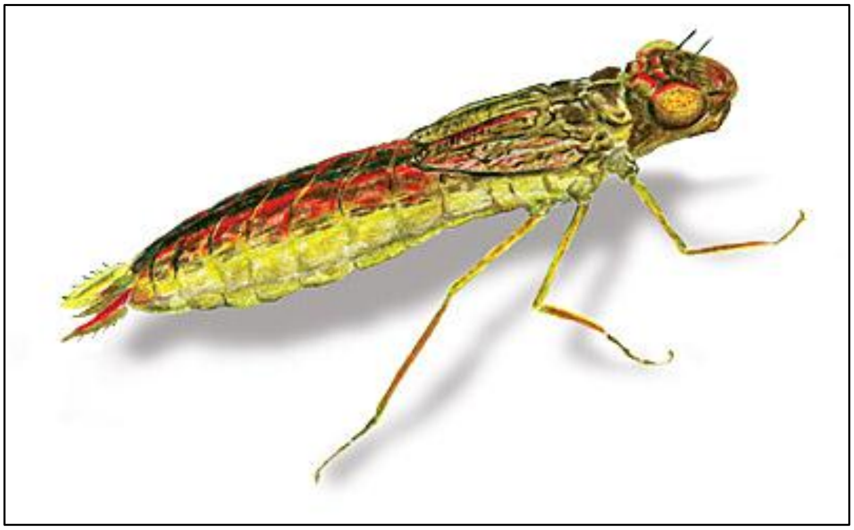


Example of Trichoptera (caddisfly) taxa from St. Johns River Water Management District.



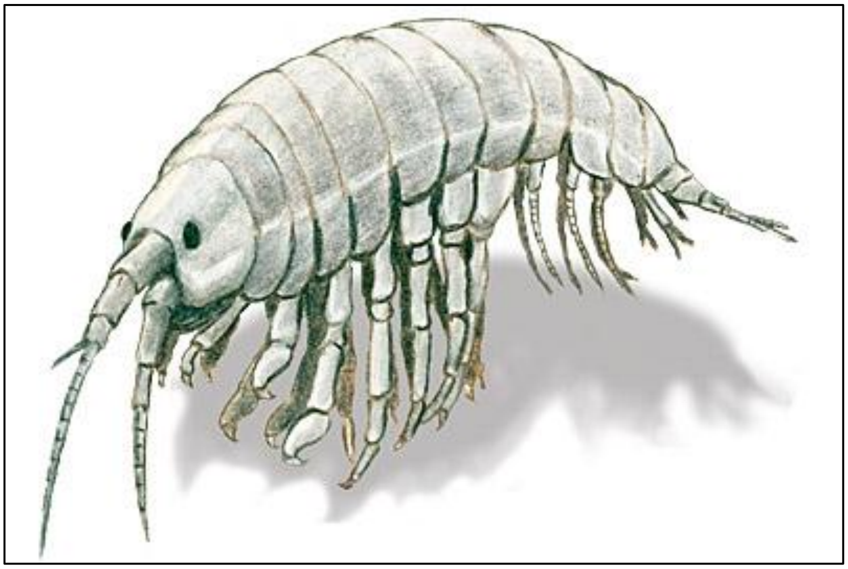
The mussel is an example of a filterer. Image from St. Johns River Water Management District.

Crayfish is an example of a long-lived species. Photo by Jonathan Francisco.



A dragonfly larvae is an example of a clinger species. Image from St. Johns River Water Management District.

Example of Tanytarsini species. Photo by James K. Lindsey.



A scud is an example of a tolerant species. Image from [St. Johns River Water Management District.]